Decision Rationale

Total Maximum Daily Load of
Fecal Coliform for the Upper Blackwater River

I. Introduction

This document will set forth the Environmental Protection Agency's (EPA) rationale for approving the Total Maximum Daily Load (TMDL) of Fecal Coliform for the Upper Blackwater River submitted for final Agency review on February 08, 2001 Our rationale is based on the TMDL submittal document to determine if the TMDL meets the following 8 regulatory conditions pursuant to 40 CFR §130.

1. The TMDLs are designed to implement applicable water quality standards.
2. The TMDLs include a total allowable load as well as individual waste load allocations and load allocations.
3. The TMDLs consider the impacts of background pollutant contributions.
4. The TMDLs consider critical environmental conditions.
5. The TMDLs consider seasonal environmental variations.
6. The TMDLs include a margin of safety.
7. The TMDLs have been subject to public participation.
8. There is reasonable assurance that the TMDLs can be met.

II. Background

Located in Franklin County, Virginia, the overall Blackwater River watershed is approximately 108,000 acres. The Upper Blackwater River watershed comprises 8,815 acres. The TMDL addresses 9.83 stream miles from Callaway, Virginia (the Confluence of the North and South Forks of the Blackwater) to the mouth of Hay Run. Forest is the major land use in the watershed and makes up roughly 56% of the 8,815 acre watershed.

In response to Section 303 (d) of the Clean Water Act (CWA), the Virginia Department of Environmental Quality (VADEQ) listed 9.83 miles of the Upper Blackwater River as being impaired by elevated levels of fecal coliform on Virginia's 1998 303 (d) list. The Upper Blackwater River was listed for violations of Virginia's fecal coliform bacteria standard for primary contact. Fecal Coliform is a bacterium which can be found within the intestinal tract of all warm blooded animals. Therefore, fecal coliform can be found in the fecal wastes of all warm blooded animals. Fecal coliform in itself is not a pathogenic organism. However, fecal coliform indicates the presence of fecal wastes and the potential for the existence of other pathogenic bacteria. The higher concentrations of fecal coliform indicate the elevated likelihood of increased pathogenic organisms.

EPA has been encouraging the States to use e-coli and enterococci as the indicator species instead of fecal coliform. A better correlation has been drawn between the

concentrations of e-coli (and enterococci) and the incidence of gastrointestinal illness. The Commonwealth is pursuing changing the standard from fecal coliform to e-coli.

Virginia designates all of its waters for primary contact, therefore all waters must meet the current fecal standard for primary contact. Virginia's standard is to apply to all streams designated as primary contact for all flows. Through the development of this and other similar TMDLs it was discovered that natural conditions (wildlife contributions to the streams) were causing violations of the standard during low flows. Based on the model, wildlife loading alone caused a violation of the water quality standard. Thus many of Virginia's TMDLs have called for some reduction in the amount of wildlife contributions to the stream. EPA believes that a significant reduction in wildlife is not practical and will not be necessary due to implementation discussion below.

A phased implementation plan will be developed for all streams in which the TMDL calls for reductions in wildlife. The first phase of the implementation will reduce all sources of fecal coliform to the stream other than wildlife. In phase 2, which can occur concurrently to phase 1, the Commonwealth will consider addressing its standards to accommodate this natural loading condition. During phase 2, the Commonwealth has indicated that it will evaluate the following items in relation to the standard. 1) The possibility of placing a minimum flow requirement upon the bacteriological standard. As a result, the standard may not apply to flows below the minimum (possibly 7Q10). This application of the standard is applied in many States. 2) The Commonwealth may develop a Use Attainability Analysis (UAA) for streams with wildlife reductions which are not used for frequent bathing. Depending upon the result of that UAA, it is possible that these streams could be designated primary contact infrequent bathing. 3) The Commonwealth will also investigate incorporating a natural background condition for the bacteriological indicator.

After the completion of phase 1 of the implementation plan the Commonwealth will monitor to determine if the wildlife reductions are actually necessary, as the violation rate associated with wildlife loading may be smaller than the percent error of the model. In phase 3, the Commonwealth will investigate the sampling data to determine if further load reductions are needed in order for these waters to attain standards. If the load reductions and/or the new application of standards allow the stream to attain standards, then no additional work is warranted. However, if standards are still not being attained after the implementation of phases 1 and 2 further work and reductions will be warranted.

The Upper Blackwater River identified as watershed VAW-L08R, was given a high priority for TMDL development. Section 303 (d) of the Clean Water Act and its implementing regulations require a TMDL to be developed for those waterbodies identified as impaired by the State where technology-based and other controls do not provide for the attainment of Water Quality Standards. The TMDL submitted by Virginia is designed to determine the acceptable load of fecal coliform which can be delivered to the Upper Blackwater River, as demonstrated by the Hydrologic Simulation Program Fortran (HSPF)[1], in order to ensure that the water quality

[1]Bicknell, B.R., J.C. Imhoff, J.L. Little, and R.C. Johanson. 1993. Hydrologic Simulation Program-FORTRAN (HSPF): User's Manual for release 10.0. EPA 600/3-84-066. U.S.

standard is attained and maintained. HSPF is considered an appropriate model to analyze this watershed because of its dynamic ability to simulate both watershed loading and receiving water quality over a wide range of conditions.

The TMDL analysis allocates the application/deposition of fecal coliform to land based and instream sources. For land based sources, the HSPF model accounts for the buildup and washoff of pollutants from these areas. Buildup (accumulation) refers to all of the complex spectrum of dry-weather processes that deposit or remove pollutants between storms.[2] Washoff is the removal of fecal coliform which occurs as a result of runoff associated with storm events. These two processes allow the HSPF model to determine the amount of fecal coliform which is reaching the stream from land based sources. Point sources and wastes deposited directly to the stream were treated as direct deposits. These wastes do not need a transport mechanism to allow them to reach the stream. The allocation plan calls for the reduction in fecal coliform wastes delivered by cattle in-stream, straight pipes, and wildlife in-stream.

Table #1 summarizes the specific elements of the TMDL.

Segment	TMDL (cfu/yr)	WLA (cfu/yr)[1]	LA (cfu/yr)	MOS (cfu/yr)[2]
Upper Blackwater	$2.01x10^{15}$	2.80×10^{9}	$2.01x10^{15}$	1.51×10^{12}
Total[3]	$3.34x10^{15}$	2.80×10^{9}	$3.34x10^{15}$	$7.06x10^{12}$

1. The WLA is based on point sources discharging to the South Fork of the Blackwater River
2. Virginia includes an explicit MOS by identifying the TMDL target as achieving the total fecal coliform water quality concentration of 190 cfu/100ml as opposed to the WQS of 200 cfu/ml. This can be viewed explicitly as a 5% MOS.
3. Total refers to the loading from the North Fork, South Fork, and Upper Blackwater River segments.

EPA believes it is important to recognize the conceptual difference between the WLA values, LA values for sources modeled as direct deposition to stream segments, and LA values for flux sources of fecal coliform to land use categories. The WLA values and LA values for direct sources represent amounts of fecal coliform which are actually deposited into the stream segments. However, LA values for flux sources represent amounts of fecal coliform deposited to land. The actual amount of fecal coliform which reaches the stream segments will be significantly less than the amount of fecal coliform deposited to the land. The HSPF model, which considers landscape processes which affect fecal coliform runoff from land uses, determines the amount of fecal coliform which reaches the stream segments. The LA in table #1 is the amount of cfu reaching the stream from nonpoint sources annually.

The United States Fish and Wildlife Service has been provided with copy of this TMDL.

III. Discussion of Regulatory Conditions

Environmental Protection Agency, Environmental Research Laboratory, Athens, GA.
[2]CH2MHILL, 2000. Fecal Coliform TMDL Development for Cedar, Hall, Byers, and Hutton Creeks Virginia,

EPA finds that Virginia has provided sufficient information to meet all of the 8 basic requirements for establishing a fecal coliform TMDL for the Upper Blackwater River. EPA is therefore approving this TMDL. Our approval is outlined according to the regulatory requirements listed below.

1) The TMDL is designed to meet the applicable water quality standards.

Virginia has indicated that excessive levels of fecal coliform due to nonpoint sources (directly deposited into the River) have caused violations of the water quality standards and designated uses on the Upper Blackwater River. The water quality criterion for fecal coliform is a geometric mean 200 cfu (colony forming units)/100ml or an instantaneous standard of no more than 1,000 cfu/100ml. Two or more samples over a 30 day period are required for the geometric mean standard. Therefore, most violations of the State's water quality standard are due to violations of the instantaneous standard.

The HSPF model is being used to determine the fecal coliform deposition rates to the land as well as loadings to the stream from point and other direct deposit sources necessary to support the fecal coliform water quality criterion and primary contact use. The following discussion is intended to describe how controls on the loading of fecal coliform to the Upper Blackwater River will ensure that the criterion is attained.

The TMDL modelers determine the fecal coliform production rates within the watershed. Information is attained from a wide array of sources on the farm practices in the area (land application rates of manure), the amount and concentration of farm animals, point sources in the watershed, animal access to the stream, wildlife in the watershed, wildlife fecal production rates, land uses, weather, stream geometry, etc. This information was put into the model. The model then combines all the data to determine the hydrology and water quality of the stream.

The hydrology component of the model for all the Blackwater TMDLs was developed on United States Geologic Survey (USGS) gage #02056900 on the Blackwater River. This was done because there were no stream gages on the other waters. The percent error of the simulated flow versus observed flow was within the acceptable limit. The model was calibrated to USGS gage #02056900 data from October 01, 1994 through September 30, 1998. The model was then validated, applied to a different time period to determine if it still accurately reflected observed conditions, to USGS gage #02056900 data from January 01, 1991 to September 30, 1994 and October 01, 1980 to September 30, 1981. The instantaneous water quality sampling data was used to determine an average ratio of flow of the VADEQ monitoring stations to the gage station. This process was then conducted for the simulated flow measurements. These ratios were then evaluated to determine the accuracy of the model on a finer (subwatershed) scale. The model was transferred to the subwatersheds to determine the fecal coliform loading. Parameters such as the fecal coliform concentration in interflow, the intensity of rainfall that will cause 90% of the pollutant to be washed off, decay rate, and the maximum accumulation of a pollutant on the land surface were changed to create a better correspondence between observed and simulated conditions.

EPA believes that using HSPF to model and allocate fecal coliform will ensure that the designated uses and water quality standards will be attained and maintained for the Upper Blackwater River.

2) The TMDL includes a total allowable load as well as individual waste load allocations and load allocations.

Total Allowable Loads

Virginia indicates that the total allowable loading of fecal coliform is the sum of the loads allocated to land based, precipitation driven nonpoint source areas (impervious areas, built-up area, distributed area, field crop, forest, hayfield, improved pasture, overgrazed pasture, poor pasture, row crop, strip crop), directly deposited nonpoint sources of fecal coliform (cattle in-stream, wildlife in-stream, straight pipes, and lateral flow), and point sources. Activities such as the application of manure, fertilizer, and the direct deposition of wastes from grazing animals are considered fluxes to the land use categories. The actual value for the total fecal load can be found in Table #1 of this document. The total allowable load is calculated on an annual basis due to the nature of HSPF model.

Waste Load Allocations

Virginia has stated that there are no point source discharging to the Upper Blackwater River. However, the Callaway Elementary School does discharge to the South Fork of the Blackwater River. Therefore, a waste load allocation has been established for this TMDL. EPA regulations require that an approvable TMDL include individual Waste Load Allocations (WLAs) for each point source. According to 40 CFR 122.44(d)(1)(vii)(B), "Effluent limits developed to protect a narrative water quality criterion, a numeric water quality criterion, or both, are consistent with assumptions and requirements of any available WLA for the discharge prepared by the State and approved by EPA pursuant to 40 CFR 130.7." Furthermore, EPA has authority to object to the issuance of any NPDES permit that is inconsistent with the WLAs established for that point source. Table #2, lists the WLA established for this TMDL.

Table #2 - Summarizes the WLAs for each point source

Point Source Name	Existing Load (cfu/yr)	Allocated Load (cfu/yr)	Percent Reduction
Calloway Elementary School	2.80E+09	2.80E+09	0%

Load Allocations

According to federal regulations at 40 CFR 130.2 (g), load allocations are best estimates of the loading, which may range form reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading. Wherever possible natural and nonpoint source loads should be distinguished.

In order to accurately simulate landscape processes and nonpoint source loadings, VA DEQ used the HSPF model to represent the Upper Blackwater River watershed. The HSPF model is a comprehensive modeling system for simulation of watershed hydrology, point and nonpoint loadings, and receiving water quality for conventional pollutants and toxicant[3]. More specifically HSPF uses precipitation data for continuous and storm event simulation to determine total fecal loading to the Upper Blackwater River from impervious areas, built-up area, distributed area, field crop, forest, hayfield, improved pasture, overgrazed pasture, poor pasture, row crop, strip crop. The total land loading of fecal coliform is the result of the application of manure, direct deposition from cattle and wildlife (geese, deer, etc.) to the land, fecal coliform production from dogs, etc.

In addition, VADEQ recognizes the significant loading of fecal coliform from cattle in-stream, straight pipes, wildlife in-stream, and lateral flow. These sources are not dependent on a transport mechanism to reach a surface waterbody and therefore can impact water quality during low and high flow events. Table #3 illustrates the load allocation for the land application of fecal coliform, the loading to each land use. The load that reaches the stream from each land use will be significantly smaller than the amount of fecal coliform deposited to the land (values reported in Table #3).

Table #3 - Load allocation for the land application of fecal coliform

Source	Existing Load(cfu/yr)	Allocated Load(cfu/yr)	Percent Reduction
Good Pasture	1.43E+16	1.43E+16	0%
Poor Pasture	4.50E+14	4.50E+14	0%
Cropland	7.97E+16	7.97E+16	0%
Forest	2.16E+14	2.16E+14	0%
Urban	2.08E+14	2.08E+14	0%
Farmstead	1.59+E13	1.59+E13	0%
Livestock Access	1.67E+14	5.49E+14	-229%
Loafing Lot	4.02E+14	4.02E+14	0%
Straight Pipes	2.44E+12	0.0	100%
Lateral Flow	1.37E+08	1.37E+08	0%
Wildlife In-Stream	3.24E+12	1.14E+12	75%
Cattle In-Stream	3.82E+14	0.0	100%

This table documents the allowable loading to each land use, a significantly smaller amount of fecal coliform will reach the stream.

3) The TMDL considers the impacts of background pollution.

A background concentration was set for all land segments by adding 10% of the total

[3] Supra, footnote 2.

wildlife load to each land segment and to the stream itself.

4) The TMDL considers critical environmental conditions.

EPA regulations at 40 CFR 130.7 (c)(1) require TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of the Upper Blackwater River is protected during times when it is most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards[4]. Critical conditions are a combination of environmental factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence but when modeled to insure that water quality standards will be met for the remainder of conditions. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable "worst-case" scenario condition. For example, stream analysis often uses a low-flow (7Q10) design condition because the ability of the waterbody to assimilate pollutants without exhibiting adverse impacts is at a minimum.

The sources of bacteria for these stream segments were a mixture of dry and wet weather driven sources. Data analysis showed that there were violations in both high and low flows. Therefore, the critical condition for the Upper Blackwater River was represented as a typical hydrologic year. However, the most stringent reductions were needed to insure that water quality standards were met during extreme low flows. A twenty-year low flow event in 1991 dictated the reductions needed in order for the stream to attain standards. It should be noted that low flow events occurred more often then wet weather events and therefore it was essential that the standard be maintained during these periods.

5) The TMDLs consider seasonal environmental variations.

Seasonal variations involve changes in stream flow as a result of hydrologic and climatological patterns. In the continental United States, seasonally high flow normally occurs in early spring from snow melt and spring rain, while seasonally low flows typically occur during the warmer summer and early fall drought periods. Consistent with our discussion regarding critical conditions, the HSPF model and TMDL analysis will effectively consider seasonal environmental variations, since a typical hydrologic year was used to calibrate the model. The model also accounted for the seasonal variation in loading. Fecal coliform loads changed for many of the sources depending on the time of the year. For example, cattle spent more time in the stream in the summer and animals were confined for longer periods of time in the winter.

[4]EPA memorandum regarding EPA Actions to Support High Quality TMDLs from Robert H. Wayland III, Director, Office of Wetlands, Oceans, and Watersheds to the Regional Management Division Directors, August 9, 1999.

6) The TMDLs include a margin of safety.

This requirement is intended to add a level of safety to the modeling process to account for any uncertainty. Margins of safety may be implicit, built into the modeling process by using conservative modeling assumptions, or explicit, taken as a percentage of the wasteload allocation, load allocation, or TMDL.

Virginia includes an explicit margin of safety by establishing the TMDL target water quality concentration for fecal coliform at 190 cfu/ 100mL, which is more stringent than Virginia's water quality standard of 200 cfu/100 mL. This would be considered an explicit 5% margin of safety.

7) The TMDLs have been subject to public participation.

Three meetings open to the public at large were held to discuss the TMDL and TMDL process. The meetings were held on November 04, 1999, February 16, 2000, and March 15, 2000 and were intended to address initial questions and concerns regarding outreach issues and the TMDL process. All of the meetings were advertised in the Virginia Register and Franklin Post,

8) There is a reasonable assurance that the TMDL can be met.

EPA requires that there be a reasonable assurance that the TMDL can be implemented. WLAs will be implemented through the NPDES permit process. According to 40 CFR 122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA. Furthermore, EPA has authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

Nonpoint source controls to achieve LAs can be implemented through a number of existing programs such as Section 319 of the Clean Water Act, commonly referred to as the Nonpoint Source Program. Additionally, Virginia's Unified Watershed Assessment, an element of the Clean Water Action Plan, could provide assistance in implementing this TMDL.

The TMDL in its current form is designed to meet the applicable water quality standards. However, due to the wildlife issue that was previously mentioned, the Commonwealth believes that it may be appropriate to modify its current standards to address the problems associated with wildlife loadings. It is believed that either because of the violation rate associated with the wildlife loadings and/or because of any modifications that may have been made, that phase 1 of the implementation process will allow the Upper Blackwater River to attain standards. The Commonwealth is investigating possibly changing the use of these waters, adding a minimum flow component, or having a natural condition amendment added to their standards.